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Students of Worcester Technical Institute

The Tech.

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WORCESTER, MASS.

THE WORCESTER POLYTECHNIC INSTITUTE.

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THE W P I

Vol. X. WORCESTER, FEBRUARY 9, 1895. No. 15.

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Since our last issue a step has been taken to remedy a long felt want. It has been a matter of regret and surprise to many that there was no literary society of any kind in the Institute. To be sure the Washburn Engineering Society is the right thing in the right place, but the Engineering Society is not wide enough in its range for the students. A man gains for his future work inestimable power by his connection with the Engineering Society, but if he relies entirely on this connection for his ability to address his fellow-men, he will soon see his mistake. What he needs is constant practice in debate and discussion, and by this we do not mean drill in the delivery of carefully written arguments, but on the other hand drill in extemporaneous speaking.

Professor Cutler, of the English Department, has for a long time recognized the above fact, but apparently has been powerless to remedy the evil. He, however, communicated his opinions to the different classes, and to some of the students personally. As a result of his remarks he was urged to call a meeting of all interested in the formation of a society to fill this need. We are glad he did so. A notice of the meeting was posted and liberally responded to by the students, showing that all that was needed was for some one to take the initiative in the matter.

The meeting held February 2d, was an excellent start. Another meeting will be held February 9th, and we hope will be attended by all. The aim of this society is not to propose more work for overburdened minds but rather to offer relaxation from labor, in such a form as to be of inestimable service to all. Topics of the day, foreign, national, and local, will be discussed, so that the tastes of all may be suited. We sincerely hope the movement will be a success, and thank the Professor of English. We would urge all the students to give the new society their hearty approval and to attend its meetings, feeling, as we do, that not only will they never regret it, but also that present and future benefit will be the result.

We are pleased to learn that a few students have gone into training for the winter ath-

letic meetings. The number training is, however, still too small to uphold the colors of the Institute properly. Think of the disgrace of last Spring, when we were left without a point to our credit! Is it to occur again this Spring? We hope not, but it is probable, unless more men come out.

Never mind if you have not shown athletic ability as yet. It is never too late to learn, and faithful work will accomplish wonders in all branches of athletics, especially in running. It may be hard at first, but stick to it and show your "sand." Remember the saying, "Genius is ability for hard work"; follow your coacher's advice; and some day you will make a record of which you will be proud.

Now, '98, be up and doing, that your fame may live after you, and future Techs may look up to you as we do to Dadmun and Lake.

The polo team suffered a severe loss when Captain Gordon was injured, but it continues to improve under the efficient coaching of Mr. Philpot. The Hartford Athletic Club men were not weak adversaries, yet Tech defeated them by a good score, the latter playing much better than against Brown. The team has been handicapped by lack of suitable ice on which to practice, but their enthusiastic work when the skating has been suitable has mitigated the evil to some extent.

We hope a game will be played with Harvard before the season is over, for we are confident that our players will render a good account of themselves, and of the Gray and Crimson.

Examinations are of the past, and also of the passed for most of us. The number of men dropped is small, but we fear conditions and low marks are quite as plentiful as at former times. However, the students now understand the eighty per cent. rule and we, having great faith in this rule, expect to see a much higher standard of scholarship this half, and, what is of less importance, much better marks at the end of the term.

"HALF WAY THRO."

The Class of '96 Celebrates.

Since its formation in January, 1893, the class of '96 has looked forward to the time when it should hold its class supper as a sign of "Half Way Thro." Its knowledge of such celebration has been obtained from classes, each one of which has claimed the prize for the best banquet, but the present Juniors have never made any pretentious claims; they have preferred to let actions speak. About a year ago a committee was appointed to have sole charge of affairs. This committee was as follows:—Fred D. Crawshaw, chairman; R. Sanford Riley, Thomas H. Coe, Everett F. Darling and Charles P. Ware. The actions of the committee were kept entirely secret, and not until a few days ago was it announced to the members of the class that the banquet would be held at the clubhouse of the Providence Athletic Club, in Providence, Rhode Island, on the night of January twenty-ninth, eighteen hundred and ninety-five.

At five o'clock on the appointed day, the Juniors commenced to gather in the Union Station, preparatory to taking the 6.15 train for Providence. A few days before, rumors had been going the rounds of the halls of dire attempts of the Sophomores to interfere with the celebration. But the rumors failed to materialize, and, without any annoyance whatever, the boys left for Providence on schedule time. The class travelled in a special car attached to the evening express. As the train pulled out of the Union Station, the cheering of the class told that it was off for a time such as only half a hundred college men can have when free from all restraint.

The interior of the car presented a gay appearance. Here and there a game of whist was in progress, while Lamson and Zaeder on alto horn and cornet led Tech songs, which were sung by nearly every '96 man. Pipes, cigars and cigarettes were in abundance, and by the time Providence was reached the air was thick with smoke. In the centre of the car was hung a large flag, and near this was placed the mascot, a huge battle-axe, which has led the class to victory in all branches of athletics. As every way-station was passed, the inhabitants were surprised by tumultuous cheering, and especially was this so when Pawtucket was reached. There

a stop of a few minutes was made, and during the entire time "Polly Wollys" and "P I's" echoed and re-echoed under the arched roof of the station. Providence was reached on time at 7.45 P. M.

All seemed anxious for the open air. The class surged out of the car and through the station, cheering as they went, surprising even the inhabitants of Providence, who are so used to the celebrations of the Brown students.

It was not a very long walk before the scene of the evening's revelries was reached. It did not take the boys long to see that the Committee had selected the very best place in New England for the evening's fun. The club-house is a magnificent six-story structure, the most prominent building on the street. The outside of the building, however, was nothing compared with the interior. It would be hard to imagine anything lacking for the advancement of a club either in a literary, athletic or any other line. The building was divided into roomy parlors and reading-rooms. A commodious billiard hall was on the third floor, and on another floor an elegant gymnasium, which made some of the boys look rather envious. In fact, the building was the most complete one imaginable, and it well deserves the name of being the finest club-house in New England.

It may be well to state here that the Committee of Arrangements was aided, to a large extent, in their choice of location for the banquet by two prominent members of the Faculty; in fact, if it had not been for them the Committee might have had hard work in making such a good impression on the members and officers of the Club. Be that as it may, '96 "got there," as it always does, and they feel justly proud of the fact that their banquet was held in the finest place which a Tech class has ever yet chosen.

After the boys arrived at the club-house they separated into parties. Some hustled out to attend the play, "Flams," at the Providence Opera House. Others went out on the busy streets to see the sights. Those of literary taste spent the evening in the reading-rooms. Some of the more sportively inclined enjoyed themselves with the ivories in the billiard hall, while others strengthened their arms in bowling. Everyone busied himself in one way or another, so that the few preliminary hours quickly passed. The pool, billiards and ten pins were free of charge.

At a few minutes before 11 o'clock, the hour set for the meal, the hungry classmen began to collect on the fourth floor preparatory to entering the dining hall. At exactly 11 o'clock the class marched into the hall and sat down to the tables, which were tastily arranged in the shape of the letter T.

The menu card was the first thing to attract the attention. This was the work of Messrs. Riley and Reed, and, to say the least, they acquitted themselves nobly. The card was by far the most novel thing ever gotten up in that line. It was in the shape of the historic old battle-axe stained with all its '95 blood. It consisted of six leaves. On the cover was a cut of the old Institute on the hill, with the words:

CLASS OF '96
"HALF THRO."

Inside, on the first page, were the customary cuts illustrating several familiar incidents. They were easily recognized by the members of the class, especially those who played prominent parts in them. On another page was a picture of the 'varsity baseball nine in which seven '96 players were readily recognized. Below it was a cut of the historic scrimmage for the battle-axe, which took place in June, '93. A prominent figure, quite close to the bottom of the pile, was the "fighting president," and beneath him the precious old mascot. On the fifth leaf was the list of toasts and the ones who responded to them, also a parody on "Auld Lang Syne." The last page contained the names of the members of the class, also the class officers and the members of the Committee of Arrangements. The third page of the card contained what was, perhaps, of most interest to the class, at the time. It consisted of the following:

MENU.

Oysters on Shell.
Puree St. Hubert aux croutons.
Broiled Pompano—Maitre d'hotel.
Cucumber salad. Duchesse Potatoes.
Pates a la Tolouse.
Filet of Beef (Financiere).
String Beans. Potatoes au Gratin.
Kirsch Punch.
Roasted Quails.
Celery and Lettuce Salad.
Camembert Cheese. Crackers. Olives.
California Fruit Ices. Assorted Cakes.
Fruit. Salted Almonds.
Coffee.

At the head of the tables sat the President, and on his left the toast-master. When the last course had been served, President F. E. Knowles, in a few well chosen words, introduced as toast-master Mr. Horace Carpenter. When the applause had subsided, Mr. Carpenter, after thanking the class for the honor conferred upon him, by a short witty speech introduced the first speaker of the evening, Mr. Fred D. Crawshaw, who responded to the toast, "Class of '96." Mr. Carpenter's introduction of each speaker was filled with sharp witticisms on the toast and speaker, which were heartily appreciated. The rest of the toasts were as follows:

"The Faculty," Henry Beyer.

"The Old and New President," Chas. P. Ware.
"Base Ball," Thos. F. Fisher,
"Hon. Stephen Salisbury," John C. Tilton.
"Football," C. Raymond Harris.
"The Ladies," Charles C. Chalfant.
"Grimy Sons of Toil," Chas. F. Leonard.
"Class Grinds," Albert B. Stone.
"Past, Present and Future," Wm. H. Cunningham.
"Agony" between whiles was rendered by the "Hybaccalarian" Quartette: Fred D. Crashaw, Horace Carpenter, Chas. P. Ware, Theo. Lamson.

The entertainment was varied by the following corps of musicians: E. F. Darling, banjo; A. B. Stone, banjo; W. E. Carroll, banjo; F. J. Zaeder, cornet; J. C. Tilton, mandolin; Theo. Lamson, guitar.

The program which was presented was as follows:

1. Cornet Solo, Mr. Zaeder.
2. Banjo Selection, Messrs. Stone, Darling and Lamson.
3. Mandolin Selection, Mr. Tilton
4. Ocarena Duet, Messrs. Lamson and Zaeder.
5. Piano, Mr. Warren.
6. Banjo, Guitar and Mandolin Selection, Messrs. Lamson, Tilton and Carroll.
7. Quartette Singing.

The singing by all of a song composed by one of the members, to the tune of "Auld Lang Syne," marked the formal close of the best "Half Way Thro" any class has yet had. The words are:

Should auld acquaintance be forgot,
And never brought to mind?
And shall we e'er forget the sport
Of days left far behind?
For auld lang syne, my friend,
For auld lang syne.
Then here's in hopes of future days
Like auld lang syne.

In old Prep days, beneath the bench,
Knowles calmly used to nap.
And Ninety-five, with fruitless zeal,
For our mascot used to scrap.
For auld lang syne, etc.

Our ball team practised in the shop
With water-box for ball.
Our sporty men received free rides
In the public carryall.
For auld lang syne, etc.

Oh, "Kinnie" used to watch the door
To see what games we tried,
While Georgie used to chase the kids
And let the German slide.
For auld lang syne, etc.

Business Meeting.

Immediately after singing of the song, President Knowles called the class to order for the regular semi-annual business meeting.

A vote of thanks was first extended to the Committee on Arrangements, and it was moved and carried to send a written vote of thanks to the Board of Governors, the Manager and the Steward of the Providence Athletic Club. Next followed the election of officers, which resulted in the election of Horace Carpenter, president; R. Sanford Riley, vice-president; Charles F. Leonard, secretary; and John C. Tilton, treasurer. C. Raymond Harris was elected class historian.

The election of the board of editors of the "Aftermath" gave rise to much discussion. The editors who were elected were: R. S. Riley, C. F. Leonard, F. D. Crawshaw, F. E. Knowles, W. H. Cunningham, and J. C. Tilton. It was decided to let the board choose its own chief.

A telegram was sent to A. L. Smith, instructor in mechanical drawing, at 2 A. M., informing him that the class would not attend his exercises on Wednesday. This telegram was sent C. O. D. It was also unanimously voted to "cut" all exercises at Tech on Wednesday. The meeting then adjourned at 4 o'clock in the morning, January thirtieth.

The train for Worcester was scheduled to leave at 6:45 A. M. The interval between the adjournment of the meeting and departure for the depot was spent in playing cards, singing songs and telling stories. At 6:30 the start for the depot was made. The cheering to the station was as loud as on the night before, and several "George Washingtons" were given in the depot. The special car was all ready and soon the train started for Worcester. Some of the men were inclined to sleep, but the majority had no such intention. Playing cards and singing, combined with practical jokes on the sleeping ones, served to make the return trip all too short. Promptly at eight o'clock Worcester was reached, and with one long and hearty cheer the class separated. Few had had a wink of sleep in the past twenty-four hours and, it is supposed, that each one went to his room to sleep, unmindful of recitations, and to dream of the class supper, which had been so eagerly anticipated for the past two years or more.

Notes on the Celebration.

The Faculty were very obliging to the class.

Some men were seen smoking who never saw a cigarette before.

Fuller was seen playing billiards. He asked his opponent who won the game.

Zaeder bowled a string of 96 ('96) pins during the evening.

Why did some members go to another car on the way to Providence?

Ask Harry Stone if the oysters were good.

They say Cunningham enjoyed himself and the soup also!

McClure was surprised when he woke up, just before Worcester was reached.

Leonard's toast was decidedly the best one of the evening.

Carpenter, as toastmaster, could not be improved upon.

Harris was somewhat off in his football statements.

Crawshaw was somewhat personal in his remarks.

Beyer had some good "take-offs" in his toast.

Fisher and Tilton were somewhat embarassed. They say Chalfant was the same.

Stone forgot some of his toasts but he "got there just the same."

Cunningham's face was somewhat pale.

Polk had a "groutch on" on the return trip.

Lamson wants to know who put the water in the hose. Ask Cullen, "Lamy."

PRESIDENT MENDENHALL'S FIRST LECTURE.

Doctor Mendenhall first considered the shape of the earth, and mentioned that from the earliest times some persons had believed the earth round. This fact was proven by the shape of the horizon at sea. A sphere is the only body that will give a circular horizon, no matter where a person stands.

The Doctor also gave a rule for finding the declination due to the curvature of the earth, as follows: Square the distance in miles, take two-thirds of this, call it feet, and we have the drop.

The lecture was very interesting, and the class expects to gain much from the course.

VENTILATION AND ITS RELATION TO HEATING AND HOUSE DRAINAGE.

CONTINUED.

On what does ventilation depend? On the difference of air pressures, I have already said. The air, so imperceptible except when in motion, is yet of enormous weight when taken in the agreggate, weighing as it does 1,033 grains to the square centimetre, or nearly fifteen pounds (14.7304) to the square inch, as we for convenience remember it.

If I should place a block or small column of almost any wood below the surface in a basin of water, and then remove my hand, the column would immediately rise, the water being heavier than the wood. And it would continue to rise, the water taking its place, until there was an equilibrium of the weight of the wood and the weight of water displaced. A block or column heavier than water would sink for a similar reason, and the bottom of the basin would have to sustain the balance of pressure.

So it is with the air. We have been told that heated air ascends, but if all the air the world over were equally heated none at the surface of the earth would ascend. It is only when one part or column only is either heated or cooled that motion of the air results.

We must heat the air in a flue, or cool the air in or about the room, or we cannot ventilate the room by means of a flue. The height of a flue or chimney increases, but it cannot create, a draught. But, if we have an outlet for foul air, we must also have an inlet for pure air, or our trial at ventilation is a failure.

"What shall we say of the houses with which architects have nothing to do, but which contain the immense majority of our people, both in cities and in the country?" Let us take first an extreme case,—a room in a tenement house, serving as a kitchen, living-room and bed-room, having a small cooking stove, one window, and one door opening into a hall which is dark and dirty. We may have occasion to visit such a room, as in a case of sickness, and it is well to know what can be done to secure fresh air for the patient.

To secure a fresh air inlet, raise the lower sash four or five inches, by placing a board underneath, one which will just fill the opening. This makes a fresh air inlet between the two sashes. The same effect can be produced by taking out one of the upper panes in the upper sash, and fitting to it a sort of hopper or funnel made of tin or pasteboard, so arranged as to deflect the air upward. Cut it out like this and bend at right angles at dotted lines.

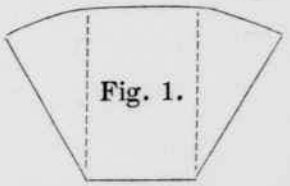

Fig. 1.

The outlet must be made in the chimney flue below the funnel from the stove. A simple way is to make an opening about nine inches in diameter, and place in it a pasteboard tube, or, better, a piece of stove-pipe with a valve or door swinging downward on the inner end, so arranged as to prevent a reverse current into the room. There is a valuable prize essay on this subject in the papers of the Massachusetts Medical Society for 1872.

Let us take next a small house of from three to six rooms, occupied by a single family. The rooms are small; the hall is not heated, and the bedrooms are warmed only on special occasions, as in case of sickness.

To save labor and fuel, there are usually but two fires, one in the kitchen stove, and the other in another stove in the sitting-room. Now, though about two million or more stoves are manufactured in the United States every year, there have been few improvements in them to aid in ventilation. "In a variety of ways," says Dr. Lincoln in the Second Annual Report of the Board of Health of the State of New York, "the stove or stovepipe can be used to expel air from the room. The *jacket*, or metal screen, is a thing of which no stove in an inhabited room should be destitute, as a protection from heat. But it is mentioned here as affording an aid to ventilation."

The seven drawings (one of which is shown in Fig. 2), were made partly from the above mentioned report and Dr. Billings' "Ventilation and Heating," but mostly from the pamphlet issued by the West Ewing, New Jersey, Improvement Society. The section of ventilating stove with open fire (Fig. 3), is from the latter source. Jackson's ventilating grates and fireplaces are from the First Annual Report of the State Board of Health of New Hampshire. (Each was briefly described). By the arrangement shown in Fig. 2, fresh warm air is introduced into the room,

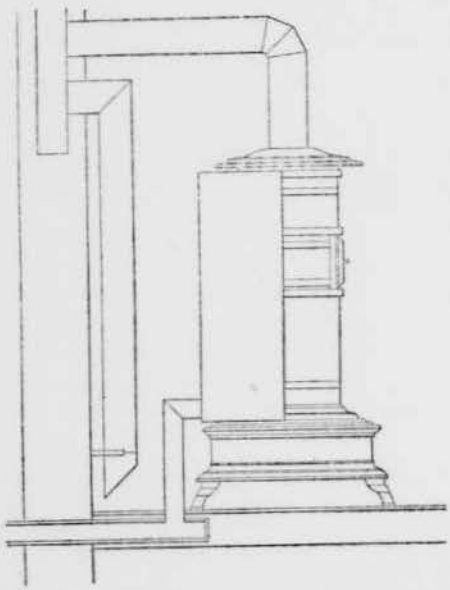

Fig. 2.—Jacketed Stove.

and foul and cooler air carried into the chimney. The heating of air by a close stove is only by contact. Yet the air does not slide along the surface. The movement is a rolling one, and has been disscribed as similar to the stripping of a glove from the finger, by turning the glove finger inside out. The windows and walls impart cold in the same way, and after the same laws of convection as the stove imparts heat; the stove forms an ascending current, while a sheet of cool air of equal heat value traverses downward the windows and cool walls. The best position for the stove appears to be where it is equidistant from the average window and cold wall surfaces.

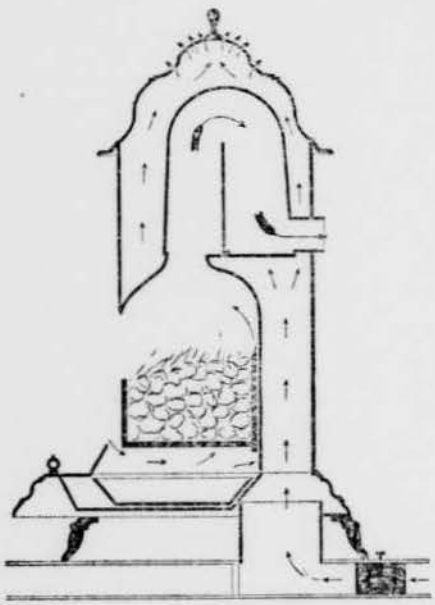

Fig. 3.—Section of Ventilating Stove.

Where to place the inlet and outlets in a room has been a much debated question. The Connecticut State Board of Health, in their third annual report, publish the experiments of the Architect, Warren R. Briggs, of Bridgeport, as to the best manner of introducing pure and properly warmed air into rooms, as well as the best position for the outlet for foul air.

The experiments were carefully conducted for the purpose of demonstrating the best manner of warming and ventilating school-rooms having a capacity of about 13,000 cubic feet, and the model used had about one-sixth of that capacity "Yet the principles involved, and the deductions that are brought out are as applicable to dwellings and places of business as they are to school buildings." The method employed was to fill the incoming flue with smoke, when the changes effected by the diffusion of fresh air with that already in the room, would be made clear to the observer. It was the aim of the architect to utilize all the heat possible, and at the same time secure a perfect change of air in every part of the room. Therefore, the inlet and outlet were changed to various points between floor and ceiling to accomplish this.

These six diagrams will explain his results.

In the first, the inlet is in the floor near outer wall; the outlet, near the ceiling in inner wall. Quoting from Mr. Briggs, "The action of the air as it enters is rapidly upward to the ceiling, where it stratifies, then along its surface to the outlet. The foul air of the room remains at the bottom, becoming constantly more contaminated. This action of warm air occasions, as may be readily seen, an enormous loss of heat, without accomplishing the very points aimed at."

In the second diagram the inlet is in the inner wall, about eight feet from the floor, the outlet remaining as in the first, but the result is practically the same.

In the next, the outlet has been lowered to the same level as the inlet, but with no better results.

In the fourth, the outlet has been placed at the floor, the inlet remaining the same. This is some improvement.

In the fifth, "both flues are at the floor level with better results than have yet been obtained, but still far from satisfactory."

So far in the experiments the inlet flue has been on the outer wall, the outlet on the inner. The second method in general use is the placing of the coil boxes upon the inner wall, and the removal of the foul air at the outer side. Mr. Briggs considers the placing of the coil boxes on the inner wall a great improvement on the other method, as by this plan they are centralized, extensive piping is saved and the danger of freezing obviated. But he writes, "The placing of the exhaust flues on the opposite side of the room, I believe to be open to the same objections that I have described in the first method."

Then he placed the inlet flue in the inner wall, about eight feet above the floor, and the outlet flue directly under it, below a platform. "By this method all the air entering is made to traverse with a circular motion the entire room before it reaches the exhaust shaft, and there is a constant movement and mixing of the air in all parts of the room (as is shown in the sixth diagram). All the heat entering is utilized and I believe that if the supply and the exhaust are properly balanced as to size, there can be but a very small loss of heat. The inlets are all intended to be large, and the flow of air through them moderate and steady."

The following are some of the considerations in the determination of the position of the fresh air regis-

ters: The position and size of the fresh air register should be such that the requisite amount of air can be introduced without causing disagreeable currents. Fresh air registers should not be placed directly below foul air registers. Flues of proper size cannot be placed in such thin walls as the ordinary interior partitions. No register should be placed in the floor so as to be flush with it, though this is so commonly done. In dwelling houses and buildings of moderate size, it would be economical to centralize the heating apparatus as much as possible, and the fresh air flues also.

Gen. Morin and the majority of modern French engineers advise that the place of introduction of fresh air shall be near the ceiling in order to avoid unpleasant currents, while the discharge openings should be near the floor. And Dr. Billings says in a conclusion, "In all dwelling-houses, however, and in rooms not having windows on opposite sides, nor containing a sufficient number of occupants to exercise any special influence on the temperature, good ventilation will be secured by placing the fresh warm air openings on the inner wall, and the discharge openings on the *same* wall at a lower level. This is the arrangement in most dwellings heated by indirect radiation."

Mr. Ruttan in his "Ventilation and Warming of Buildings," well states what we should all remember: "If we want to ventilate our room to cool it, we must let our air *out at or near the top* (of the room), and supply its place with cool air, which, of course, will distribute itself over the floor of the apartment. (And this has been the policy in nearly all our former modes of ventilation). Proceeding on the erroneous notion that cold air *only* could be pure, they have actually been freezing the people when they wanted to warm them."

"If, on the other hand, we want to ventilate our room to warm it, we must take the air out at or near the *bottom;* thus keeping up a continuous exhaustion of the cooler air." And, if we wish to set the body of air in the room in motion, upward or downward, we must, of course, bring in the necessary amount of outside air to do it. If we want to warm the room, the air we bring in must be warm; and if to cool it, it must be cool."

According to Dr. Billings, "If the inlet openings are to be directly in the outer walls, and not connected with the windows, the best form is the Sheringham valve, which is much used in English barracks. In this the air enters through perforated bricks or an opening covered with wire gauze, or perforated zinc, and is then directed upward by a valved opening, the deflecting plate of which is so arranged that it can be set at any angle, or made to close the opening entirely. The internal opening of those valves usually measure nine by three inches."

In regard to the ventilation of larger dwellings, of schools, audience halls and theatres, I have only the time to speak in a rather too hasty manner. From the standpoint of a ventilating engineer, all buildings may be divided into two general classes. Those in which the air is cooled in its passage, and, therefore, must be heated, as it enters the building, above the normal temperature of the rooms; and secondly, those buildings in which the air is heated in its passage, as in a theatre. In this class the air introduced must be cooler than the normal inside temperature.

Surgeon Bailhache of the U. S. Marine Hospital Service, says: "The system of ventilating and warming introduced by Gouge of New York, based on the increased force air gains by being gathered into different sized tubes, partially inserted one into the other, and started by means of a gas jet or lamp, is novel and said to be very satisfactory, particularly in large buildings and railroad cars, where it has been pretty extensively adopted." This principle of induction is quite plainly shown in this diagram.

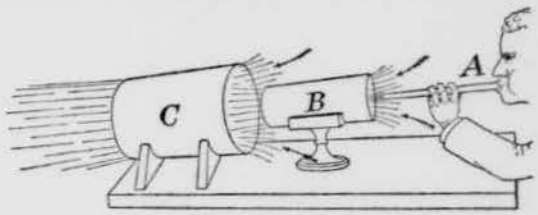

Fig 4.—Experiment Showing Induction.

He also says: "The Ruttan-Smead system is fast becoming very popular, many school-houses and public buildings being heated and ventilated by it. The principle is the down draught or vacuum system, with the additional advantage of utilizing the heated air after it has left the rooms or halls by its passing numerous openings under the floors, thus keeping them warm, and being again collected in a gathering room, where it is further used for ventilating the privies and urinals located in the basement; it thence passes into the heated ventilating shaft." This system I have seen in very satisfactory operation at Chelsea, Mass., in one of the school-houses.

Warren R. Briggs of Bridgeport, Conn., whose experiments in heating and ventilation we have described, designed a system of warming and ventilating school-houses, which met with considerable discussion and opposition, but was quite successful and popular afterward, except where the apparatus used were not properly selected. The illustrations here shown (Figs. 5 and 6), are from Mr. Briggs's paper in the first annual report of the New Hampshire State Board of Health. "In the Bridgeport school," writes Mr. Briggs, "the coil boxes for the heating of the various rooms have all been placed in the main ventilating shafts in the *centre* of the building, and the air conveyed from them through these shafts to the rooms by means of metal tubes. The air enters the inner corner of the room about eight feet from the floor, the corner being clipped so as to form a flat surface. The outgoing flue has been placed directly under the platform, which is located in the *same corner* as the introduction flue." This platform is on castors and its lower edge is four inches from the floor.

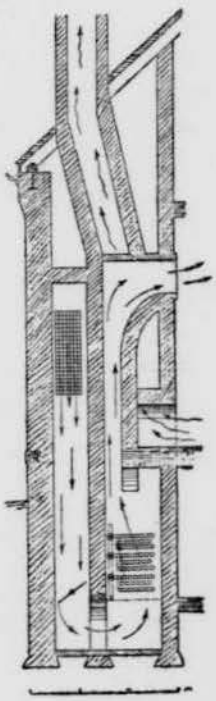

Fig. 5.—Vertical Section of Flues.

The Mills system of ventilation has worked well at the Springfield, Mass., prison. It has since been installed in the Pierce Building, at Copley Square, Boston, where it promised excellent results. Mr.

Walworth said it was the best system he had ever seen. It is similar to the system I shall describe later.

The system in use at the Metropolitan Opera House in New York, designed by Frederick Tudor of Boston and J. C. Cady, the architect, of New York, has prodeuced a very equable temperature. I do not know how well the system preserves the purity of the air. I should like to describe both these systems, if time permitted, as well as the one about which I shall next speak. It would be interesting to compare the results obtained.

The arrangement for the ventilation of the Walker Building at the Mass. Institute of Technology may be said to have marked a new departure in the ventilation of large buildings. It was designed by Prof. S. H. Woodbridge of the M. I. T. The air for the ventilation of the building enters through a basement window of 100 sq. ft., on the lower side of the building, passes through a battery of steam pipes having a free area of 120 sq. ft., and then is forced by a fan into the sub-basement chamber which thus becomes the plenum. From this the air can pass into 47 flues in the interior and 31 in the exterior walls, having an aggregate section of 240 sq. ft. All the heating surface is located in the sub-basement.

The leading features, as sought in the operation of the system, are thus summarized by Prof. Woodbridge:—

"First, a reversal of the ordinary custom of subordinating ventilation to supposed economy in heating. Second, a volume and distribution of air supply based on the determined requirements rather than on the cubic capacity of rooms. Third, a large area of air conduits and passages, and low velocities of air flow. Fourth, an adjustment of supply and discharge areas such as to produce a slight internal pressure. Fifth, a location of supply and discharge apertures chosen with a view to the most efficient and economic use of the air supply. Sixth, an exclusive control of air supply and of room temperature by the engineer. Seventh, a registering of hourly rate and daily aggregate of steam condensation, as furnishing a basis for critical study in determining the necessary cost of ventilation.

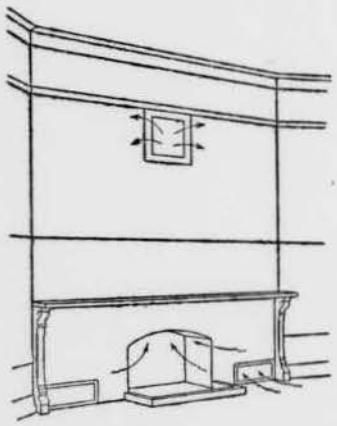

Fig. 6.—Corner of School-Room. Briggs.

The same method employed at the Walker and Engineering buildings of the M. I. T. has been successfully applied to school buildings, of which the High School building at Lynn, Mass., is perhaps the best example. The following description is quoted from the report of Prof. Woodbridge, who was the designing engineer:

"The supply enters the building through four windows facing the northern lawn and aggregating something over fifty sq. ft. area. It is warmed to 65° by passing through a battery of 2000 sq. ft. of steam pipes, of such form as to furnish a free area of 85 sq. ft. for the flow of air through it. The fan which draws the air through the windows and steam coils, and thus forces it through the under-floor ducts and the flues, is one of special design, being 8 feet in diameter, and having a double and coned inlet of 5′ 8″ diameter, the width at the periphery being 15 inches; it is three-quarter housed, the brickwork at the end of the main duct, over which it stands, completing the scroll and housing. At a speed of 160 revolutions and an expenditure of 14.5 horse-power the fan moves nearly 60,000 cu. ft. of air a minute. The fan is driven by a belt from a Westinghouse "standard" engine, which also drives a 5 feet exhaust fan.

"The air supplied to the school-rooms enters them by two ways, and in approximately equal parts by each way: first, by the flues, of which each room has one 3′x1′; and second, through the coridors by the central transom, or othewise by the middle door. The air moving through the flues is warmed from 65° to the required temperature by a specially constructed coil of 40 sq. ft. surface placed within the flue near its bottom. The admission of steam to these coils is controlled by electric thermostats within the rooms and pneumatically operated steam valves. The warming is therefore done by three means: first, by the use of so much of the main coil as the coldness of the weather demands for raising the air to 65°; second, by the supplementaries within the flues and corridor boxes; third, by direct radiation," to be used when required and for hastening morning warming. The quantity of air supplied to each of the school-rooms in this building averages 140,000 cu. ft. per hour. The proportion of carbonic acid thus far found in the rooms ranges from 5.2 to 5.7 parts in 10,000 of air.

"Some of the methods adopted for increasing the economy and effectiveness of the working of the system should be further noticed. By means of successive rather than separate ventilation, the play-rooms, corridors and wardrobes are continuously and freely ventilated by air on its way to the school-rooms. By the same method the boiler-room is ventilated and cooled by the air en route to the lavatories, whence it moves, in part, through and ventilates the closets and urinals. The exhaust steam of the engine is used in three sections of the main coil, and is found sufficient to warm the entering air through 20° or so. The steam's small loss of heat in transit through the engine makes the cost of the power used practically insignificant. The exhaust from the pumps in the boiler-room, and the heat of the vapor pipe from the blow-off tank, are used to warm the air in the shaft which ventilates the lavatories. The condensed water from the exhaust-steam section of the main-coil is made to yield its heat to the cold feed-water supplied to the boilers. The engine, separator, heater, reducing valves and the entire ganglion of branch and distributing pipes are located in the fan-room, where their heat is yielded to the air supply instead of being lost by overheating rooms which must be cooled by open windows. Economy is also effected in labor, and fuel saved by the automatic regulation of the boiler fires, and of the steam pressures in the boilers and the three heating systems, by the automatic control of temperatures in the air chambers and the rooms, and by the automatic regulation of the pumps which return the

water to the boilers. The engine also is as automatic as it is practicable to make one." "The fuel cost of ventilation has been found to be 1.44 lbs. per day for each of 750 scholars, making the per capita cost about a quarter of a cent per day.

COMPARATIVE TABLE.

From the Annual Report of the School Board of the City of Lynn of 1892.

High School Buildings.	Total Wall Surface.	Glass Surface.	Sides Double Sashed.	Maximum Number of Scholars.	Air Supply in Cu. ft. per Room.	Tons of Coal Burned in School Year 1892-'93.	Pounds of Coal to each Occupant.	Cost of Heating and Ventilating Apparatus.
Cambridge,	35,000	6,500	2	670	?	400	1,200	$15,000
Worcester,*	33,000	7,900	0	600	30,000	350	1,166	17,000
Roxbury,	35,000	6,900	4	550	35,000	300	1,091	30,000
Lynn,†	38,000	7,800	0	750	58,000	260	693	23,000

*This was before the automatic regulation of the boiler fires.
†The use of Cumberland coal in this building effected a saving of $380.

"The buildings compared in this table are the four largest high school buildings recently erected in Eastern Massachusetts. In the matter of exposure, one building has no marked advantage over another. The Cambridge building is without mechanical means of ventilation, and the power of the heating plant is so low that all-night firing is found necessary to insure early morning warmth. The building is also more used than any other of the four for afternoon and evening schools. The air supply to this school is admitted through a score or more of basement-wall inlets, and its volume cannot easily be measured. It is doubtless variable, though averaging well. In this building, as in the Worcester English High, the vent shafts are heated, and fuel is expended in warming air as it passes out of the building."

In Keith's New Theatre in Boston, which I visited with Prof. Woodbridge, we have an example of an excellent arrangement for that class of buildings, judging by the results obtained. While in the best ventilated of the other Boston theatres the proportion of carbonic acid was from 16. to 22. parts in 10,000 of air, in Keith's, when filled on Patriots' Day, the proportions were 5.4 on the floor, 6.7 in first balcony, and between 9 and 10 in the gallery. I wish that I had time to describe the ventilating system in detail.

In conclusion, I hope that whatever of this we forget, we will not forget the value of pure air, nor how to bring it into our dwellings; for by ventilating our houses with pure air, and so only, can we make the best of material possessions—healthy homes.

POLO TEAM.

Another Creditable Victory.

The Tech polo team played its second game on Saturday, Feb. 2, at the Lake, before a small number of spectators and amid many difficulties. The day was stormy but the previous day had been pleasant and Manager Beyer had no time, after the storm commenced, in which to cancel the game. However, Tech had its usual stormy day luck and won. They had as their opponents the team representing the Hartford Athletic Club, and to have won so easily from them is quite an honor. With one exception, this is the team which played the whole of last season without losing a game. They came to Worcester, expecting to have an easy victory over our team, but received a bitter defeat.

When the Tech team arrived at the Lake they found that no place had been cleared for the game. They immediately went to work and soon, with the aid of the spectators, had a space cleared for the game. Then Manager Beyer hustled around and had the cages drawn from the boat-landing to the spot, near the ice houses, where the game took place. This was accomplished at about 3.20 and then the game commenced.

For the first five minutes of play it looked as though Tech had little chance of winning. During this time the Hartford boys gave a fine exhibition of polo, passing and juggling well and making some good drives for goal. Meanwhile, Tech seemed to be napping, but when Hartford won her first goal they waked up, and when they had tied the score they seemed to gain courage, and from this point on there was no doubt as to the outcome of the game.

For Hartford, the defensive work of the Donovan brothers at goal and half-back was the feature. W. Donovan had twenty-seven stops in goal, an extraordinary record in ice polo. D. Donovan put up a great game at half-back and saved Hartford several goals by his clever blocking. C. Schults also put up a good game at first rush. In the third period he received a blow in the neck from the ball and was obliged to retire from the game. D. Donovan took his place, while J. Donovan played half-back.

The whole Tech team put up a great game, showing marked improvement over the work in the Brown game. They played together like a machine, and their passing, juggling and blocking off was much better than in the previous game. Philpot especially distinguished himself. Time and again he took the ball from in front of his own cage, rushed it down the centre and then either made a good drive for goal or a pretty pass to one of his rushers. Knowles and Warren did some pretty rushing and passing and made many fine drives for goal. Sibley at half-back put up a fine blocking game, stopping many hard drives. Harris kicked out well, at one time having three stops in rapid succession.

C. Schults took the first rush, and keeping possession of the ball rushed it toward the Tech goal. Here, after four minutes of fast work, he succeeded in caging it. This proved to be Hartford's only point.

Warren took the next rush, and Tech began to brace up. For ten minutes the ball went back

and forth, and then was finally caged by Warren on a fine pass by Knowles. During this time both sides gave a good exhibition of polo. But now that Tech had tied the score they seemed to be endowed with fresh courage, and from this time on they completely outplayed their opponents.

Knowles took the next rush, and it was soon caged by Warren after some clever passing. Schults took the next rush, but soon lost the ball, and it was driven into the cage by Knowles. Knowles took the next rush, and time expired, with the ball close to the Hartford goal.

In the next period Knowles captured all the rushes, and he and Warren each succeeded in putting the ball inside the cage.

In the last period Hartford played almost wholly upon the defensive and tried to keep the score as low as possible, but Tech got three goals in this period. The last goal was caged by Knowles. Warren drove it into the cage, and it rolled out, but Knowles put it there again and it stayed. The line-up was as follows:—

TECH.		HARTFORD A. C.
Knowles, Warren,	Rushers.	C. Schults (Capt.), Caldwell.
Philpot (Capt.)	centre.	W. Schults.
Sibley,	half-back.	D. Donovan.
Harris,	goal.	W. Donovan.
	Substitute,	J. Donovan.

Rush.	Goal.	Caged by.	Time.
C. Schults,	Hartford,	C. Schults	3.30
Warren,	Tech.	Warren.	10
Knowles,	Tech.	Warren.	2
C. Schults,	Tech.	Knowles.	2
Knowles.	Limit.		
Knowles.	Tech.	Knowles.	6
Knowles.	Tech.	Warren.	6
Knowles.	Limit.		
Warren.	Tech.	Warren.	2
C. Schults.	Tech.	Warren.	2
Warren.	Tech.	Knowles.	3.30
Caldwell.	Limit.		

Stops in goal: Harris 10; W. Donovan, 27.
Referee, Riley; timer, Ramirez.

COMMUNICATION.

To the Editor of the W P I:

There has recently been so much criticism of the Senior course in Steam Engineering and, in my opinion, such misconception of the true cause for complaint, that I take the liberty of making a few suggestions.

The root of the whole trouble, I think, lies in the general plan of the course, which was probably laid out under the superintendence of the Faculty, who are, therefore, the responsible parties.

The class has taken up Zeuner's diagrams as applied to the plain D and Meyer valves and that of the straight-line engine, and has designed a boiler. For this work, one afternoon (4 hours) a week was assigned and no work was expected outside of the class room. Now the subject of valve setting is a special, and one of the higher branches of machine design, and requires very considerable application on the part of any who do not take naturally to the subject; the manual labor of drafting takes considerable time and the hours are all too few. The result has been a grand scramble in which a few intelligently finished their work, but in which the great majority completed their designs almost mechanically. *Too much* work in *too short* a time, caused the failure of many on the examination.

But, granted that this work requires more time, is it the best under the circumstances? Have not the Faculty in their desire to give *practical* instruction, gone to the other extreme and over-emphasized details? In other words, are they not making too much of a specialty whose broad outlines only, are necessary to the average mechanical engineer? Physicists have adopted, and are adopting, many standards which govern their world and secure the necessary bases of comparison in their delicate experiments. Mechanics are far behind them in this, nor does it seem probable with conflicting commercial aims and the constant improvements of processes, that even a general uniformity will be reached for many years; indeed, many manufacturers make it a point to depart from established methods, either that their work may not be duplicated, or for similar reasons.

A young engineer *must* learn largely from experience, but he can first get a good foundation to build upon, and this is why I plead for a broader course, in which subjects of more general application may be brought up. Such, for instance, as a brief study of boilers (a redeeming feature of the present course), the elements of compound and triple expansion engines, common defects in engines and boilers, &c., &c. Such a course calls for a man of practical experience, and the advantages would be inestimable.

In making these suggestions I am not blind, as some seem to be, to the practical difficulties to be encountered—difficulties which may make immediate change impossible. I do think, however, that the Faculty should give the matter careful consideration, and hope that some definite results will soon be seen. '95.

A NEW SOCIETY.

On Saturday, February 2d, a meeting was held in room 19, Boynton Hall, by those interested in the formation of a society of the nature of a Current Topics Club. For a long time some of the students and Faculty have felt the need of

such a club, and for the past few weeks more talk than usual on this subject has been heard. As a result this meeting was called by Prof U. Waldo Cutler. Prof. Cutler called the meeting together and Mr. Riley, '96, was elected chairman of the meeting, with Mr. Dana, '97, as secretary. The meeting was addressed by Prof. Haynes, on the advantages and disadvantages which such a society might bring. It was voted that a committee of five, one member from each class and one from the Faculty, be chosen to report on the aims and scope of the society. The committee elected was Prof. Cutler, chairman, A. W. Clement '95, J. W. Chalfant, Jr., '96, H. S. Lancaster, '97, and H. C. Smith, '98. A committee on constitution and by-laws was appointed by the chair, this committee consisted of Dr. Haynes, Mr. Morse, '97, and Mr. Polk, '96. These committees were requested to report at the next meeting, February ninth. Several opinions concerning the object of the society were expressed by students and members of the Faculty, who were present at the meeting.

The meeting was largely attented, but the majority of those present were Juniors and Sophomores, with here and there a Senior or Freshman. The lack of '95 men can be accounted for by the fact that the Seniors are in the Shop or Laboratories Saturday mornings.

ATHLETICS.

The outlook for a successful season in athletics is brighter at the present time than it has ever been before at this season of the year. Considerable interest is manifested in track athletics especially, and Capt. Allen, together with the directors of the association, is pushing things along rapidly.

The rink has been secured for training purposes between the hours of five and six each day. Fifteen men began training last week, and Capt. Allen expects to have over thirty at work by the last of this week.

The services of trainer Donovan have been secured, and he will have charge of the men four nights a week, Monday, Wednesday, Thursday and Saturday nights. He entered upon his duties last Monday.

Every fellow should appreciate the advantages of having such a trainer as Mr. Donovan, and make it a point to always be on hand. It ought also to be a great inducement for new men to train, for they can feel assured of receiving good care and proper instruction. Tickets for admittance to the rink have been issued, and those who are to train may secure these from the captain. Only men who are training will be allowed in the rink while the team is at work.

The Tech will probably enter a team to run with the Boston Tech team at the City Guards' Meet, to be held in the rink Feb. 14th.

TECH INDOOR MEET.

The directors of the W. P. I. A. A. held a meeting Feb. 1st and made arrangements for an indoor meet to be held in the rink March 14th.

Most of the events will be for Tech men only, and all will be handicap races.

The events will be as follows:

Open to Tech men only.

40 yards dash.
600 " run.
1000 " "
1 mile walk.
High jump.
Pole vault.

Open to all.

Mile walk.
600 yards run.
1 mile invitation race.

There will also be a class championship relay race. Each man will run two laps, and it will doubtless be a close race between the two upper classes. Good prizes will be offered in all events and it is hoped to make this meet a success financially as well as from the point of getting out new men in the Institute.

DIRECTORS OF W. P. I. A. A.

The directors have organized with Dr. L. P. Kinnicutt, chairman, and Mr. George A. Denny, secretary. Committees on the various branches of athletics were also appointed as follows, track athletics: Prof. Conant, Mr. Penniman, Mr. Denny. Base ball: Mr. Beels, Mr. Fish, Mr. Harris. Foot ball: Dr. Kinnicutt, Mr. Gordon, Mr. Morse, '97.

PROF. MORSE'S LECTURE.

The general lecture course was continued on Monday, Feb. 4, by Professor Edward S. Morse of Salem, who took for his subject, "The Theory of Evolution." The lecturer proved to be most entertaining, and was liberally applauded at frequent intervals, while he kept the students in a roar of laughter at times. He talked rapidly and earnestly and illustrated his points, as he went on, by blackboard sketches, which he produced with remarkable rapidity.

TECHNICALITIES.

'90. At the recent annual meeting of the Board of Trustees of the Jones' Home for Friendless Children of Cleveland, Francis W. Treadway was elected legal adviser and counsel for the ensuing year.

NEW SENIOR LECTURE COURSE.

A new departure in the way of lectures was started last Friday, when a meeting of the Senior class was called in room 19 at 4.30 P. M.

President Mendenhall stated that he had decided to give a course of lectures on "The Earth and its Astronomical Relations."

These lectures will take place weekly on Friday at 4.30.

Pres. Mendenhall stated the need of such a course in a school of this kind, and also the difficulties attending the preparation and delivery of a course on the subject on account of our lack of facilities in this line.

The official announcement of the results of the semi-annual examinations is quite satisfactory. The Senior and Junior classes have contributed very largely to the list of unfortunates, while the two lower classes have made a most enviable record, maintaining a good standing in scholarship.

Senior class, actual loss is five. Three are allowed to drop back into the next class, while two may continue, as special students. The Junior class has also lost five. Four of these may repeat; the fifth may, to regain his standing. The Sophomore class loses one man, while the Freshman's single loss is allowed to repeat with the next class.